

forcing cellular providers to negotiate restrictive settlements in order to put needed sites into service.<sup>57</sup>

In each of these cases, cellular carriers have been required to go to extraordinary lengths to deploy new facilities and modify existing facilities, even where scientific reports and environmental assessments prove such sites are well below relevant exposure standards. With the vast quantities of misinformation that exist,<sup>58</sup> cellular carriers are required to conduct rigorous and detailed site assessments, undertake extensive education programs for local decision makers, and bring in expert testimony in order to defend the safety of proposed facilities and alterations. And, even with the full cooperation of the decision makers, the record compiled in a local hearing cannot approximate the data that, for example, will be before the FCC in its determinations. Furthermore, even with an adequately developed record, decision makers often lack the resources or expertise to render

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<sup>57</sup> See Resolution No. 93-1130 by G. Johnson, Chairperson, Board of Supervisors, Sacramento County, California (Aug. 24, 1993) (containing Settlement Agreement terminating *Friends of Fair Oaks Village v. County of Sacramento* (Sacramento Cty Sup. Ct No. 372242)).

<sup>58</sup> Despite that one judge characterized a certain Dr. Marino as "barely qualified as an expert [in the field of electromagnetic radiation effects], and a separate judge described his testimony as "kindergarten stuff", Dr. Marino's testimony has been used to coerce PacTel into a settlement in Sacramento, California, and was offered in Portland, Oregon, as evidence warranting a reexamination of the city's RF exposure ordinance. See Report of Proceedings in *re Bendure v. Kustom Signals, Inc. et al.* at 92-93, Case No. C91-1173SAW (D.C.N.D.Cal. Jan. 5, 1993); Report of Proceedings in *re Verb v. Motorola et al.* at 28, Case No. 93 CM 969 (Ill. Cir. Ct. Cook Cty July 29, 1993); p.23, *supra*. Unscientific evidence is accepted at these hearings, further inflaming fear and emotion. One press release describing a proposed cellular facility contained the following statements, without any scientific basis: (1) "[t]hese electromagnetic fields will *triple* your risk of getting *leukemia*"; (2) "[t]hey cause the human system to deviate from its normal functions and *suppress the immune system*"; (3) "[t]hey stimulate existing cancer cells by permanently increasing their growth rate by as much as 1600%, thereby *increasing tumors of all kinds* (One Texas study showed brain cancer deaths to be 13 times higher among workers exposed to magnetic fields)"; (4) "[t]hey cause *lower birth rates & higher infant mortality* rates in babies born to mothers living in areas with high electromagnetic field exposure"; and (5) "[e]xposure to the electromagnetic fields [sic] have been found to cause *learning disabilities*, a higher incidents [sic] of *mental disturbance*, and even *suicides*." Pamphlet distributed regarding "Bell Atlantic's Request for a Special Exception for a Variance of the Butler Township Zoning Law" (emphasis in original).

informed decisions.<sup>59</sup> It is also evident that decision makers may lack the impartiality to render rational decisions, since in many cases the individuals responsible are elected by, or are fellow property owners with, those opposing a proposed facility.

McCaw's experiences in New York alone provide several concrete examples of the burdens of and harms to consumers caused by local and state RF exposure regulation. Since McCaw acquired control of the Cellular One affiliate in the New York City regional MSA, McCaw has embarked on an ambitious program to improve and expand service in this difficult urban radio environment. Because New York City is a "concrete canyon" that has a very high population density, and because of the extreme geographic constraints in the outlying market areas, improving service has meant adding new cell sites--34 in 1992 and 64 in 1993. However, questions and concerns about RF exposure have delayed and adversely affected cell siting to the point where McCaw now must obtain detailed RF site assessments for approximately half of its new cell sites, and even with such reports, site permits are being denied. The following examples illustrate the magnitude of these problems:

- **Dobb's Ferry.** Cellular One applied for a use variance in October of 1990 for a new site at Dobb's Ferry. After six separate appearances before the Zoning Board of Appeals ("ZBA"), including submission of a detailed cell site assessment report and

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<sup>59</sup> In West Hollywood, for example, a McCaw affiliate obtained a staff level decision that concluded a proposed use was permitted, noting that health and safety from RF exposure were beyond the jurisdiction of the local board. Although Los Angeles Cellular Telephone Company offered the testimony of an expert consultant with a doctorate, the city council sided with "the testimonies of Mary Worley and Marielen Martin and submitted documents *referencing* various studies," and the council denied the permit based on its determination "that the installation of additional roof-top microwave antennas and cellular antennas may be detrimental to the public health and safety." See *A Resolution of the City Council of the City of West Hollywood Granting Appeals by Mary Worley and Others and Marielen Martin and Others of the Planning Commission's Approval of Conditional Use Permit 93-04 on an Application of Dan Hare for L.A. Cellular To Permit the Placement of Roof-Top Cellular Antennas at an Unstaffed Cellular Telephone Facility Located at 9044 Melrose Avenue, West Hollywood* (adopted Oct. 25, 1993) (emphasis added). According to one report of the case, Mary Worley, a retired medical aide, contended that "radiation from cellular antennas caused cancer that killed one of her pet dogs and caused three other pets to become ill." *EMF Litigation News* at 535 (Nov. 1993).

expert testimony, the variance was denied on April 10, 1991, based in part on the *unsupported* "fears" of RF radiation expressed by citizen's groups. This decision was appealed in June of 1991, and the court reversed the ZBA denial on January 29, 1992. Despite the court's determination that no doubt was cast on Cellular One's expert testimony, the citizens' lobbies appealed this decision and Cellular One was forced into new litigation. Again, Cellular One prevailed, this time in the appellate court in December of 1992. A subsequent appeal, in the New York Court of Appeals, only recently upheld the December 1992 decision.

- **Mount Kisco.** In October of 1991, Cellular One filed for a zoning variance to modify an existing facility at Mount Kisco that had been operated since 1986. The modification requested authorization to replace a wooden monopole with an 85 foot steel monopole and sectorize the antenna at the site. The ZBA denied a variance on September 16, 1993, citing concerns over the potential increased health risk as a result of Cellular One's proposed antenna design change.
- **Northport.** Cellular One began searching for a cell site in the Northport area in October of 1990. Finally, in March of 1993, after being forced to change the search area many times, Cellular One received approval to install an antenna on a 69 foot water tank. After receiving a building permit in July of 1993, an appeal was filed against the site premised, in part, on health and safety grounds.
- **East Northport.** In late 1990, Cellular One proposed to replace an existing 100' lattice tower on a sod farm with a 100 foot monopole. This modification was opposed, mainly on concerns expressed regarding proximity to two schools. Because the town zoning board *never* issued a decision, Cellular One was forced to split the search area into two sites. Although one of the new sites went on line in October of 1993, the other site has now been opposed in an appeal against Cellular One and the town.
- **Huntington.** In early 1990, Cellular One proposed to erect a 125 foot monopole on a horse farm on Long Island. This site was opposed and a major issue was health and safety. After 2 1/2 years of opposition, the site was finally relocated to a water tank where no local zoning approvals were required.
- **Glen Cove.** On May 12, 1992, Cellular One applied for a building permit to install cellular antennas on an existing water tank and for an underground modular building. This permit was denied and sent to the City of Glen Cove Planning Board for site plan approval only. After a number of hearings where concerns over RF exposure were expressed, the site plan was denied based on the inappropriateness of a cell site too close to residential homes. This decision was appealed on October 28, 1992, and annulled as arbitrary and capricious and an abuse of discretion. Nonetheless, the City of Glen Cove filed a further appeal, obtained an automatic stay, and the case is still pending.

- **Greenburgh.** Another New York jurisdiction, the town of Greenburgh, has stated that it will not allow the construction of *any* cell site facilities within city limits due to RF exposure concerns, despite the advice of the city's counsel that such action would be contrary to established law.

The problems of state and local regulation of RF exposure are not confined to New York. Even in locales where explicit references are made to a safety standard such as the ANSI standard, local boards have nonetheless denied zoning variances and planning board permits based on unsubstantiated fears of RF exposure.<sup>60</sup> Based on recent trends, McCaw believes that these situations are likely to proliferate:

- In California, the state public utility commission ["CPUC"] recently adopted a strategy of "prudent EMF avoidance" for power line emissions, a position originally advocated by a citizen's group.<sup>61</sup> If the same strategy is adopted for cellular facilities in a companion proceeding, McCaw may not be able to build *any* new cell sites. Even worse, in this companion proceeding, this same group has called for a strategy of "superprudent avoidance" for cellular, stating that "cellular telecommunications offers some added convenience, [but] is by no means an essential public service"<sup>62</sup> and recommending an "immediate freeze on the expansion of the state's cellular radiotelephone network."<sup>63</sup>

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<sup>60</sup> In Tampa, Florida, despite an ordinance explicitly referencing the ANSI standard and a proposed site in compliance with the standard, the local zoning board denied the permit for a zoning variation on RF health grounds. This denial resulted in the need to relocate the site and a four month delay in providing service to the public. Similarly, in Portland, Oregon, which has adopted RF exposure limits identical to the ANSI/IEEE 1992 standards, Cellular One obtained a Conditional Use Permit to install a cellular antenna on top of the Portland Memorial building located in a cemetery. Based on concerns over health issues, a year later Cellular One was forced to abandon the possibility of using the site, even though the base station met the Portland safety standard. Cellular One has now identified two sites it will need to cover the same territory as the single site would have covered, and will now be required to submit to two separate permitting processes.

<sup>61</sup> Proposed Decision of Chief Administrative Law Judge Lynn T. Carew at 12, Cal. Pub. Util. Comm'n (Jul. 12, 1993).

<sup>62</sup> This statement is ironic in light of the role that the cellular communications network has played in coordinating safety and disaster relief in California, as evidenced by the San Francisco and Los Angeles earthquakes and the Yosemite and Santa Barbara fires.

<sup>63</sup> Comments of Toward Utility Rate Normalization at 8, Cal. Pub. Util. Comm'n Case No. OII.92-01-012 (filed Apr. 8, 1991).

- In Portland, Oregon, a citizen's group has called for zero tolerance RF exposure limits ("as near zero as feasible") in and within 1/4 mile of residential areas and near schools, hospitals, and care facilities.<sup>64</sup>
- San Francisco has banned antennas on schools, despite the health department having determined that there was "no clear health basis to proscribe such installations at schools."<sup>65</sup>
- In Sacramento, PacTel recently entered into a settlement agreement with a local group to expedite the construction of a needed site. Although PacTel was successful in obtaining the use of the site, the settlement may be construed as a *de facto* standard for all future cell sites in the Sacramento area and includes provisions limiting exposure from the site to 0.01 mW/cm<sup>2</sup>. In fact, the settlement has already been used to reopen the question of cell site safety in Portland, Oregon, even though Portland already has ordinances in place requiring compliance with its own RF safety exposure limits, and has been cited in permit hearings as far away as New York.

The aggregate effect of these measures is to delay service to the public, unnecessarily raise costs, and, in some cases, deny service to the public altogether.

**B. State and Local Oversight of RF Exposure Threatens the Public's Interest in Development and Maintenance of a High Quality, Low Cost, Ubiquitous, Spectrum-Efficient Cellular Communications Network**

As discussed below, the three federal agencies with primary responsibility over RF exposure appear to be in broad concurrence that the limits in ANSI/IEEE C95.1-1992 are the most appropriate means for protecting the public and workers from emissions from cellular base station facilities. The FCC should, in this proceeding, take the additional step of determining that requirements to comply with more restrictive exposure standards

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<sup>64</sup> Neighbors of Westmoreland Press Release at 5 (Sept. 13, 1993).

<sup>65</sup> Letter from Raymond R. Neutra, M.D., Dr.P.H, Acting Chief, Environmental Health Investigations Branch, State of California Department of Health Services, to William L. Lee, M.S., C.I.H., Director, Bureau of Toxics, Health and Safety Services at 1 (dated Aug. 18, 1993). *See, generally*, "San Francisco Bans Cellular Antennas on School Property," *Microwave News* at 1, 10, vol. XIII no. 6 (Nov./Dec. 1993).

unnecessarily constrain the development of cellular radio systems. The exercise of local jurisdiction over RF exposure is blocking or delaying access to new sites and the modification of existing sites, thereby frustrating the federal goal of achieving a ubiquitous, reliable, spectrum-efficient and low cost nationwide cellular network.

**1. The FCC is the appropriate agency to establish regulations to assure safe use of cellular service in the public interest**

This proceeding, rather than a multiplicity of local fora responding to speculative fears of RF radiation, is the proper context for developing standards for RF exposure and balancing the goals of safety and the use of cellular radio facilities in the public interest. With the recent filings by the FDA and EPA, the record in this proceeding offers a unique opportunity to resolve questions of RF exposure in a rational manner. As discussed below, while the FCC, FDA, and EPA may differ on the merits of various aspects of ANSI/IEEE C95.1-1992, at cellular frequencies there is unanimity on all significant aspects of the proposed standard. Based upon this unanimity and the FCC's unique expertise in radio frequency matters, the *Report and Order* in this proceeding will stand as the adoption of a federal standard that assures health and safety.

The *Notice* and the comments already filed in this proceeding show a consensus among the federal agencies generally responsible for RF exposure regulation--the FCC, the FDA, and the EPA. The FDA's Center for Devices and Radiological Health ["CDRH"], for example, has supported the adoption of the ANSI/IEEE standard with a few specific concerns

that are generally not relevant for cellular base facilities.<sup>66</sup> Similarly, the EPA has supported adoption of the NCRP standard, which, like the ANSI/IEEE standard, uses a formula of  $[(f/1500 \text{ Hz}) \text{ mW/cm}^2]$  to determine the maximum permitted field strength at cellular frequencies. Both CDRH and the EPA also conclude that "[t]he majority of [the] relatively few studies [on non-thermal effects] indicate no significant health effects are associated with chronic, low-level exposure to RF radiation."<sup>67</sup> Based upon this broad concurrence that the exposure levels in ANSI/IEEE C95.1-1992 are sufficient to protect the public and workers from exposure to cellular base station facilities, the FCC should further determine that requiring compliance with standards that are more restrictive than this consensus federal standard does not offer increased protection and adversely affects the public interest in access to cellular radio services.

**2. State and local RF oversight frustrates rational and logical deployment of cellular networks that serve the public interest**

Concerns over health issues are increasingly being used as justification for denying new cell sites and restricting carriers' ability to sectorize cells and add channels to existing facilities. Because base station transmission facilities are the building blocks needed to provide service to cellular customers, state and local RF exposure oversight is frustrating the deployment and development of affordable cellular services. Today there are over 13 million cellular subscribers, 9500 new subscribers signing up for service each day, and over 11,511

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<sup>66</sup> CDRH objects to the low-power exclusion, a clause that obviously would not apply to cellular base stations. *FDA Comments* at 1-2; *see also* n.15, *infra*.

<sup>67</sup> *EPA Comments* at 2-3, 5; *see also FDA Comments* at 2.

operational base transmission facilities.<sup>68</sup> With the current growth trends, 4,000 additional cell sites will be needed in 1994 to provide coverage in new areas and to provide additional capacity and higher quality coverage in existing areas. Furthermore, McCaw's efforts to improve service and lower costs through the deployment of digital technology depend on the ability to modify equipment at existing sites. If permission is denied at the local level based on misinformation and irrational speculation, the promise of enhanced services, improved accessibility, and lower cost will never become reality.

Even under the best of circumstances, the number of new cell sites required to maintain and extend the nation's cellular network would be a problem. However, several factors serve to further restrict the availability of high quality, low cost service for the public:

- To expedite the deployment of new sites by minimizing the effect of delays and denials of local government permits, cellular engineers often identify and simultaneously attempt to obtain permits for a number of alternate sites within a "search ring." These "search rings" are defined by system expansion needs and become smaller as a system matures. In some metropolitan areas, a "search ring" may be limited to a single block or a single building. Thus, as the network continues to develop, access to specific sites is necessary and pursuing clearances for multiple sites becomes infeasible. In any event, pursuing multiple sites unnecessarily consumes time and resources that would be better used to improve services to the public.
- Selecting alternate sites presupposes that the problem at issue is denial of local permits. In many cases, outright denial is not the problem, but rather the long process of educating state and local authorities regarding health issues that are plagued with emotionalism. In many instances, the delays and costs to the public incurred in such efforts will not be avoided by selecting alternate sites, but instead merely transferred to a different forum. Such delays are not in the public interest--whether in terms of safety or service.

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<sup>68</sup> Telecommunication Reports at 2 (Oct. 11, 1993).

- In many jurisdictions today, zoning or use permits are strictly limited in time or in terms of the precise number of transmitters the carrier needs when the permit is granted. Thus, every time a system requires technical modification, it is subject to additional local oversight and the potential for delay or denial is introduced.

By frustrating carriers' ability to build and modify sites needed to expand service consistent with the cellular model of frequency re-use, local oversight of RF issues affects important FCC policies. It also affects the ability to introduce and deploy technical advancements, like digital. As discussed below, by not allowing carriers to develop systems consistent with efficient cellular design goals, local planners are, in effect, thwarting achievement of nationwide, ubiquitous, reliable cellular service. In addition, by interposing delays and difficulties into the conversion of systems to smaller cell radii, which reduces overall power, state and RF regulations discourage efficient use of the spectrum and require the use of higher power facilities with greater exposure potential.

### **3. The FCC can and should preempt state and local oversight of cellular on RF exposure grounds**

Preemption of state RF exposure regulation is within the FCC's statutory authority under the Communications Act. Under the Supremacy Clause of Article VI of the Constitution, Congress has the power to preempt state law where the state law stands as an obstacle to the accomplishment and execution of the full objectives of Congress.<sup>69</sup> The

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<sup>69</sup> *Louisiana Pub. Serv. Comm'n v. FCC*, 476 U.S. 355, 368-69 (1986) (citing *Hines v. Davidowitz*, 312 U.S. 52 (1941)).

power of preemption in such circumstances also extends to federal regulatory agencies acting under delegated authority from Congress.<sup>70</sup>

The federal authority over cellular facilities is uncontested and the federal interest in assuring the availability of a reliable nationwide cellular network evident. Section 151 of the Communications Act states the authority of the Commission to regulate interstate commerce "in communication by . . . radio so as to make available, so far as possible, to all the people of the United States a rapid, efficient, Nation-wide and world-wide . . . radio communications service."<sup>71</sup> Furthermore, Section 301 also grants the Commission "exclusive jurisdiction" in the area of "overall management of the radio spectrum and the licensing of radio facilities."<sup>72</sup>

Any state--or local<sup>73</sup>--regulations that impede or thwart the federal goal of creating an efficient nationwide cellular network can thus be preempted by the Commission.<sup>74</sup> Indeed, the Commission has already acted to preempt state regulation of entry and technical

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<sup>70</sup> *Fidelity Federal Savings & Loan Ass'n v. De la Cuesta*, 458 U.S. 141, 152-54, 159 (1982); *Capital Cities Cable, Inc. v. Crisp*, 467 U.S. 691, 698-700, 716 (1984).

<sup>71</sup> 47 U.S.C. § 151 (1988).

<sup>72</sup> *See Cellular Communications Systems*, 86 F.C.C.2d 469, 504 (1981) (citing *NARUC v. FCC*, 525 F.2d 630 (D.C.Cir. 1976), *modified*, 89 F.C.C.2d 58 (1982); 47 U.S.C. § 301 (1988).

<sup>73</sup> Local regulations, since they are enacted under authority granted by state constitutions and statutes, would also be preempted by a federal exercise of preemption over state laws.

<sup>74</sup> Achieving "nationwide cellular service" and "effectiv[e] and efficient[]" use of cellular service are explicit federal goals. *See Cellular Communications Services*, 89 F.C.C.2d 58, 96 (1982).

standards for cellular services to promote realization of standardized, nationwide cellular service to the public:<sup>75</sup>

Title III of the Communications Act of 1934, as amended, provides us with adequate authority to assert federal primacy [in these areas]. In addition, the federal plan for provision of cellular service set forth in our Order, principally the goal of introducing nationwide compatible cellular service without undue delay, and the fact that cellular systems are to be interconnected with the public landline telephone network and capable of providing interstate as well as intrastate communications, provides a further basis for this Commission asserting federal primacy over licensing of cellular facilities.<sup>76</sup>

Assertion of exclusive federal jurisdiction over RF exposure regulation would serve the same goals by removing a significant roadblock to the introduction of new services and modification of cellular facilities.

In addition, the inability to procure sites is defeating carriers' ability to make the most efficient use of spectrum in accordance with Section 303(r) of the Communications Act. Since carriers' efforts to develop networks of smaller radius cellular facilities are being effectively blocked by unjustified concerns regarding RF exposure, cellular carriers have not been able to migrate to lower power transmitters.<sup>77</sup> Furthermore, the permitting process associated with modifying existing facilities is blocking efforts to transition to digital cellular transmitters, which will increase spectrum efficiency by a factor of 3 or more without adding

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<sup>75</sup> *Cellular Communications Systems*, 86 F.C.C.2d at 505 (stating "[o]ur licensing scheme requires assurance that the . . . radio spectrum allocated for cellular service is used effectively and efficiently"); *Cellular Communications Systems*, 89 F.C.C.2d at 95.

<sup>76</sup> *Cellular Communications Systems*, 89 F.C.C.2d at 96.

<sup>77</sup> Since the distance between the portable and the base station is a factor in the closed loop system that adjusts the portable's power automatically, the inability to add fill-in sites affects portable transmit power as well as base stations. Ironically, the inability to build a new site often results in cellular facilities and phones transmitting at higher power levels than they would if the new site had been approved.

additional sites. Under the circumstances, state and local RF regulation is obstructing the goal of "ensur[ing] that the 40 MHz of radio spectrum allocated for cellular service is used effectively and efficiently."<sup>78</sup>

The FCC has not hesitated to preempt state and local regulations in cases where such regulations frustrate federal policies.<sup>79</sup> Indeed, the FCC itself has noted that it *must* preempt inconsistent state regulations.<sup>80</sup> Because increased local oversight over RF exposure is "adversely affecting a licensee's ability to engage in Commission-authorized activities," federal primacy must be asserted.<sup>81</sup>

**C. Preemption Can Be Implemented in a Limited Fashion That Minimizes the FCC's Administrative Burdens and Places Effective Limits on the Extent of Permissible State and Local RF Exposure Oversight**

Preemption of local oversight over RF exposure can be narrowly tailored and implemented in a manner that ensures that federal communications policy goals will be met without commitment of excessive administrative resources by the FCC. As previously discussed, the major difficulties faced by carriers are the result of attempts by local

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<sup>78</sup> *Cellular Communications Systems*, 89 F.C.C.2d at 94

<sup>79</sup> *See, e.g., Louisiana Pub. Serv. Comm'n*, 476 U.S. 355; *American Broadcasting Co. v. FCC*, 191 F.2d 492 (D.C. Cir. 1951); *Bodony v. Incorporated Village of Sands Point*, 681 F. Supp. 1009 (E.D.N.Y. 1987); *Van Meter v. Township of Maplewood*, 696 F. Supp. 1024 (D.N.J. 1988); *Satellite Earth Stations (Preemption)*, 59 Rad. Reg. 2d (P & F) 1073, *recon. denied* 61 Rad. Reg. 2d (P & F) 608 (1986); *Vertical Blanking Interval*, 57 Rad. Reg. 2d (P & F) 832, *recon. denied*, 58 Rad. Reg. 2d (P & F) 819 (1985); *Hon. Harvey I. Sloane*, 35 Rad. Reg. 2d (P & F) 845 (1975).

<sup>80</sup> *See Use of Subsidiary Communications Authorization*, 98 F.C.C.2d 792, 799 (1984) (citing *Florida Lime & Avocado Growers Inc. v. Paul*, 373 U.S. 132, 142-43 (1963)).

<sup>81</sup> *Report and Order*, 100 F.C.C.2d at 558.

authorities to address exposure issues *de novo*. Specifically, many jurisdictions are attempting to create new exposure regulations in response to misinformation or speculative information on non-thermal effects. Few such local agencies, however, have the expertise or background to make such determinations. McCaw believes that the FCC should solicit comment on preempting state and local oversight of RF exposure from cellular transmissions.

McCaw believes that this limited preemption could be effectively undertaken in a manner that does not impose burdens on carriers or the FCC. Under McCaw's plan, carriers applying for new facilities would continue to certify that environmental processing was not required if the proposed site complies with MPE limits established by the Commission's *First Report and Order* in this proceeding. Based on this certification and a well crafted preemption policy guideline, any attempts by localities to reopen health issues could be foreclosed at the start of local proceedings. At the same time, such a preemption policy would allow local governments to continue exercising their jurisdiction over the aesthetics of cellular facilities. By not allowing local groups to cloak aesthetics concerns with unscientific RF health claims, a narrowly tailored preemption policy would assure the availability of an efficient, reliable, cellular service as well as the protection of public health.

#### **IV. CONCLUSION**

For the reasons discussed herein, McCaw supports the *Notice's* proposal to adopt the 1992 ANSI/IEEE standards as the basis for the Commission's rules regarding RF exposure. The ANSI/IEEE standard represents the consensus of the scientific community, incorporates substantial implicit and explicit safety margins to protect public health, and is founded upon

an extensive scientific database. Based upon adoption of this standard, McCaw also believes that the Commission should continue the categorical exemption for Part 22 and Part 21 base station transmitter sites. Empirical evidence shows that Part 22 and Part 21 facilities typically operate well within the ANSI/IEEE exposure limits and thus are unlikely to exceed the safety standard. In addition, based upon the empirical evidence, the Commission should standardize RF exposure regulation by preempting state and local regulation in this area.

Respectfully submitted,

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January 25, 1994

**TAB A**



# ENTITY POSITION STATEMENT

## HUMAN EXPOSURE TO RF EMISSIONS FROM CELLULAR RADIO BASE STATION ANTENNAS

1828 L STREET, NW SUITE 1202, WASHINGTON, DC 20036-5104  
(202) 785-0017

We recognize public concern for safety of microwave exposure from cellular communications base stations. Guidelines for limiting exposure have been published by the American National Standards Institute, the Institute of Electrical and Electronics Engineers, and other national and international organizations. These guidelines were developed to protect workers and the general population from harmful exposure to radiofrequency electromagnetic fields. Based on present knowledge, prolonged exposure at or below the levels recommended in these guidelines is considered safe for human health. Measurements near typical cellular base stations have shown that exposure levels normally encountered by the public are well below limits recommended by all national and international safety standards. Furthermore, public exposure near cellular base stations is not significantly different from the usual "RF background" levels in urban areas, which are produced by radio and television broadcast stations present in every modern community. Therefore, one can conclude that exposure from properly operating cellular base stations is safe for the general population.

There may be circumstances where workers could be exposed to fields greater than the standards specify. In those cases, generally on rooftops, access can be and should be restricted.

This statement was developed by the Committee on Man and Radiation of the United States Activities Board of The Institute of Electrical and Electronics Engineers, Inc. (IEEE), and represents the considered judgment of a group of U.S. IEEE members with expertise in the subject field. The IEEE United States Activities Board promotes the career and technology policy interests of the 250,000 electrical, electronics, and computer engineers who are U.S. members of the IEEE.

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IEEE United States Activities Board

May 1992

Approving Entity

Date

## **BACKGROUND**

The acceptance and use of cellular radios and cellular telephones, which operate in continuous wave mode at carrier frequencies between 825 and 845 MHz (mobile transmitters) and between 870 and 890 MHz (base station transmitters), has increased dramatically during the past few years. To keep up with the demand for available radio channels and to ensure quality of service, there is a continual need for additional cells in many metropolitan areas and their suburbs. The installation of cell site or base station antennas frequently raises concerns about their environmental impact and safety. In addition to commonly asked questions about the aesthetic/visual impact of towers, many communities raise concerns about exposure of the public to radiofrequency energy transmitted by these sites, particularly people who live or work in the vicinity of the antennas.

The cell-site antennas are usually located on towers, either free-standing monopoles or lattice type, ranging in height from 30 to 75 meters. In many cases it is more convenient to locate antennas on the top or side of other existing structures, such as water tanks or buildings. The antenna height is critical; it must be high enough to provide coverage throughout the cell but low enough to preclude interfering with remote cells. Each cell site contains both transmitting and receiving antennas. The number of antennas depends on the service area, e.g., in an extremely high density service area six transmitting antennas, each with up to sixteen radio channels, could be used.

The maximum total effective radiated power (ERP) of a system would depend on the number of channels authorized at a site. Typically, there are 16 transmitting channels (discrete-frequencies) per cellular antenna. As many as six transmitting antennas (for a total of 96 discrete frequencies) could be used at a given site, but this number is unlikely. Furthermore, all channels would not be expected to be operating simultaneously, thus reducing overall emission levels.

The Federal Communications Commission (FCC) authorizes up to two cellular telephone companies in each service area. Although the FCC permits an ERP up to 500 watts per channel (depending on the geographical area and tower height), the majority of the cell-site in urban and suburban areas operate at ERPs of 100 watts or less per channel. In large cities the cells are small and the ERP is usually 10 watts per channel. The transmitters associated with "microcells," usually located within buildings, railroad stations, etc., operate at ERPs lower than 1 watt. The system is self-limiting in the sense that as the system expands and cells are subdivided, the transmitter power is reduced to prevent interference with remote cells. As with other antennas used for telecommunications the energy from a cell-site antenna is directed toward the horizon in a relatively narrow beam in the vertical plane. As one moves away from the antenna, the power density decreases as the inverse square of the distance, and consequently, the exposure at ground-level in the vicinity of an antenna tower is relatively low compared with the exposure very close to the antenna itself. Measurements made around typical cell-site antenna towers have shown that ground-level power densities are well below limits for the general population recommended by recognized organizations, such as the American National Standards Institute (ANSI-C95.1, 1982), the IEEE (IEEE-C95.1, 1991), the National Council on Radiation Protection and Measurements (NCRP, 1986) and the International Radiation Protection Association (IRPA, 1988), which range from 2.75-2.97

milliwatts per square centimeter ( $\text{mW}/\text{cm}^2$ ) for occupational exposure to 0.41-0.45  $\text{mW}/\text{cm}^2$  for general population exposure at cellular radio frequencies of 825-890 MHz.

The maximum exposure levels found near the base of typical cell-site antenna towers are, in fact, lower than all national and international recommended safety limits. These maximum exposure levels occur only at the limited distances close to the base of the tower. For example, data submitted to the FCC showed a maximum measured ground-level power density at the base of a 45 meter tower to be of the order of 0.00002  $\text{mW}/\text{cm}^2$  per radio channel, corresponding to 0.002  $\text{mW}/\text{cm}^2$  for a 96 channel, 100 watts ERP per channel, fully implemented system. The antennas were omni-directional colinear arrays. The maximum was found to occur typically at distances between 18 and 25 meters from the base of the tower. At other points within 90 meters the levels were considerably lower; on average less than 0.0001  $\text{mW}/\text{cm}^2$  for 96 channels. Similar measurements made in the vicinity of higher towers yielded correspondingly lower values. Measurements show that the power density at distances greater than 60 meters from all commonly used directional and omni-directional cell-site antennas is less than 0.010  $\text{mW}/\text{cm}^2$  including points in the main beam. RF radiation from nearby cellular base stations does not significantly increase the reported "RF background" levels in urban areas (Tell and Mantiply, 1980).

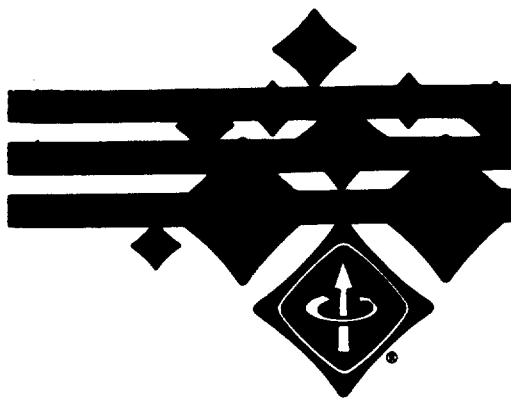
Because of building attenuation, the power density levels inside of nearby buildings at corresponding distances from a cell-site antenna would be from 10 to 100 times smaller than outside (depending on building construction). Thus the maximum levels inside of buildings located near the base of a typical 45 meter cell-site antenna tower will be between 0.0002 and 0.00002  $\text{mW}/\text{cm}^2$ . Measurements made directly in the beam of a roof-mounted omni-directional antenna with sixteen radio channels indicated that the power density was less than 1  $\text{mW}/\text{cm}^2$  at a distance of 3 meters from the antenna and less than 0.010  $\text{mW}/\text{cm}^2$  beyond 50 meters. Thus, in certain areas on the rooftop, depending on the proximity to the antenna, the exposure levels can be higher than those allowed by the safety standards. Access to these areas should be restricted. Measurements show that in rooms directly below roof-mounted installations, the power density levels are considerably lower than roof locations, depending on the construction. For typical construction (e.g., wood or cement block) the attenuation is about a factor of 10. The power density behind sector (directional) antennas is hundreds to thousands of times lower than in front, and hence, levels are negligible in rooms directly behind walls where sector antennas are mounted on the sides of buildings.

In conclusion, measurements and calculations have verified that the power densities associated with cellular radio cell-site antennas to which the public may be exposed are not significantly different from "RF background" levels in urban areas which are produced by radio and television broadcast stations present in every modern community, and are well below the limits recommended by national and international safety standards. Based on this comparison, cellular communications base station emissions are safe for the general population. There are circumstances where workers could be exposed to fields greater than the standards specify. In those cases, generally on rooftops, access should be restricted.

## REFERENCES:

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5. NCRP. (1986), (Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields). Report 86, (Bethesda, MD: National Council on Radiation Protection and Measurements) pp.1-382.
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**TAB B**



# **ENTITY POSITION STATEMENT**

## **HUMAN EXPOSURE TO RADIOFREQUENCY FIELDS FROM PORTABLE AND MOBILE TELEPHONES AND OTHER COMMUNICATION DEVICES**

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This Statement was developed by the Committee on Man and Radiation of the United States Activities Board of The Institute of Electrical and Electronics Engineers, Inc. (IEEE), and represents the considered judgement of a group of U.S. IEEE members with expertise in the subject field. The IEEE United States Activities Board promotes the career and technology policy interests of the 250,000 electrical, electronics, and computer engineers who are U.S. members of the IEEE.

We recognize public concern about the safety of exposure to radiofrequency (RF) energy from portable and mobile telephones and other communication devices. Recommended exposure limits and guidelines have been published by the American National Standards Institute, the Institute of Electrical and Electronics Engineers, the National Council on Radiation Protection and Measurements, and the International Radiation Protection Association. These guidelines were developed to protect workers and the general population from harmful exposure to RF fields. Based on present knowledge, prolonged exposure at or below the levels recommended in these guidelines is considered safe for human health by us.

Prolonged RF exposures from any source should not be allowed if they result in a rate of RF energy absorption in the various portions of the body that exceed these guidelines. Measurements have shown that routine exposures of users and other persons to low power portable and mobile transceivers and cellular telephones (see page 3 for definition of low power) do not induce rates of RF energy absorption that exceed any of the maximum permissible rates of energy absorption defined by these guidelines. Furthermore, intermittent transmission during operation of certain transceivers lowers the time-averaged induced rates of energy absorption. Therefore, based on present knowledge, the exposures from low-power transceivers and cellular telephones are considered to be without risk for the users and for the public. However, some non-cellular mobile transceivers operating at high power levels produce intense fields for which prolonged exposure near the antenna could exceed safety criteria. Because of the relatively high field strengths near the antennas of high-power mobile transmitters, operators should follow safety precautions recommended by the manufacturers.

## **BACKGROUND**

Portable and mobile transceivers (transmitter and receiver) and cellular telephones are used extensively in contemporary communications. Some people are concerned over the safety of exposure to the RF energy associated with the use of these devices. Portable units have antennas that are usually located close to the human body. Antennas used with mobile units are mounted on a vehicle; e.g., roof, front or rear deck, and are, therefore, normally at a distance from the user. The parameters of concern with respect to human health are the mass-averaged and time-averaged rate of energy absorption, called specific absorption rate (SAR), and the incident power density. Due to the different antenna configurations and power levels of various units, the discussion is divided into portable units (hand-held and transportable) and mobile units.

### **A. RF Safety Standards and Guidelines**

Safety standards and guidelines for human exposure to RF fields include those issued by organizations such as the American National Standards Institute (ANSI), the National Council on Radiation Protection and Measurements (NCRP), the Institute of Electrical and Electronics Engineers (IEEE), and the International Radiation Protection Association (IRPA). The maximum permissible exposure values are practically the same for all these safety standards and guidelines in the frequency band of portable communication devices. It should be noted that the ANSI/IEEE limits were derived for the purpose of health protection, regardless of the mechanisms of the effects. The ANSI RF protection guides (ANSI-95.1, 1982), adopted for use by the Federal Communications Commission (FCC) in 1985, limit the peak SAR to 8 W/kg and the SAR averaged over the body to 0.4 W/kg. In terms of incident power density, the 1982 ANSI-C95.1 exposure limits are frequency-dependent. The permissible levels are 1 milliwatt per square centimeter ( $\text{mW}/\text{cm}^2$ ) at 150 MHz,  $1.5 \text{ mW}/\text{cm}^2$  at 450 MHz, and  $2.75\text{-}2.83 \text{ mW}/\text{cm}^2$  for frequencies between 824 and 850 MHz, the transmitting frequency band used for portable and mobile cellular transceivers.

The IEEE-C95.1-1991 incident power density limits are also frequency-dependent. The power density limits for a "controlled environment" (any location where people are aware of a potential exposure) are the same as the ANSI 1982 limits up to 1500 MHz and one-fifth of the ANSI 1982 values for the "uncontrolled environment." A detailed definition can be found in the IEEE-C95.1-1991 standard. The maximum time-averaged SAR is 8 W/kg delivered to any one gram of tissue in the shape of a cube for six or more minutes for controlled environments and a corresponding value at 1.6 W/kg for exposure in uncontrolled environments for 30 or more minutes. Higher local SARs are allowed for shorter exposure durations. The NCRP recommendations are also based on a maximum, time-averaged, localized SAR of 8 W/kg for occupational exposure and one-fifth of the occupational level, i.e., 1.6 W/kg, for exposure of the general population (NCRP, 1986).

In 1988, the International Radiation Protection Association (IRPA, 1988) issued guidelines for human exposure to radiofrequency fields. For occupational exposure of the head, the allowable incident power density is  $2.06\text{-}2.13 \text{ mW}/\text{cm}^2$  at 824-850 MHz; the average SAR is 0.4 W/kg; and the peak SAR is 10 W/kg. The values for the general population are one-fifth of the corresponding values for occupational

exposure. In addition, the IRPA guidelines contain an exclusion for low-power devices which have an output of less than 7 W.

RF devices are excluded from the maximum permissible exposure (MPE) limits of the ANSI C95-1982 and the IEEE C95.1-1991 exposure standards, if they meet certain criteria. The 1982 standard states that devices radiating less than 7 W and operating between 450 and 1500 MHz are considered safe. This protection guide was adopted for use by the Federal Communications Commission (FCC) in 1985. However, further restrictions have been incorporated into the MPE of the recently revised version of this standard (IEEE C95.1, 1991). Devices that are used in a controlled environment and operate at frequencies between 100 kHz to 450 MHz are excluded if they radiate less than 7 W of power. Devices operating above 450 MHz are acceptable in a controlled environment if the maximum average radiated power is less than the value given by the following relation:

$$\text{Maximum average radiated power} = 7 (450/f) \text{ Watts,}$$

where  $f$  is the frequency in MHz. The maximum power so defined by the formula ranges from 7 W at 450 MHz to 2.1 W at 1500 MHz. For exposure in an uncontrolled environment, corresponding exclusion is a maximum average radiated power of one-fifth of the above values (1.4 W at 450 MHz to 0.4 W at 1500 MHz). For practical purposes, the latter exclusion applies to cellular transceivers with power levels below about 0.74-0.76 W. The rationale for excluding these lower power devices is that, although they may emit localized fields exceeding the MPE, laboratory studies have indicated that low-power devices meeting the exclusion criteria are incapable of exceeding in normal use the whole-body-averaged and the time-averaged peak SAR limits of the standard.

## **B. Portable Transceivers and Telephones**

Depending on the service, portable transceivers typically transmit at frequencies near 30, 150 and 450 MHz, and in the 806-850 MHz band. The antenna of a hand-held transceiver is usually located close to the head during use, while the antenna of a transportable (typically configured as a small attache case or a luggage-type unit that can be carried over the shoulder) can be located close to other parts of the body during use. The SAR produced by hand-held transceivers placed near models of human heads has been extensively studied under several conditions (Balzano, et al., 1977, 1978a, 1978b; Chatterjee, et al., 1985; Cleveland and Athey, 1989; Kuster and Balzano, 1992). These studies included the worst-case situation, where the hand-held transceiver and its antenna were placed as close as possible to the head and eyes of the human head model. Most researchers agree that lens opacities (cataracts) can be induced only by exposures that cause significant heating of the lens. The cataract formation requires an SAR of over 100 W/kg delivered continuously for many minutes (Kramar, et al., 1975). Chronic exposure of test subjects to 2450 MHz continuous waves at 10 mW/cm<sup>2</sup> (SAR 17 W/kg), 23 hours a day, for 6 months did not cause any observable effects (Guy, et al., 1980).

The results of a study carried out at 30 MHz, where a 6.4-watt transceiver was placed near a tissue-equivalent model of the human head, indicated that the maximum SAR was less than 0.3 W/kg. The energy coupling at this frequency is low, since the antenna is long, and therefore, most of it is located

away from the head (Balzano, et al., 1979). At 150 MHz, a 6.4 W VHF transceiver produced a peak SAR of 0.5 W/kg at the surface of the head 2.5 cm above the eyebrow (Balzano, et al., 1978a). At 450 MHz, 6.4 W radiated from a whip antenna produced an SAR of 1.2 W/kg at the surface of the eye, and the same power radiated from a helical antenna produced an SAR of 0.9 W/kg at the surface of the eye (Balzano, et al., 1978b). Cleveland and Athey (1989) carried out a similar study at frequencies between 810 and 820 MHz and between 850-860 MHz. When transceivers were held 1 cm or less from the head, the peak SAR was induced in the eye or the head. The worst-case SARs at 810-820 MHz were 3.2 W/kg per watt at the surface of the eye and at 850-860 MHz were 3.5 W/kg per watt at the temple.

The SAR distribution is also affected by the position of the antenna relative to the head and depends on the antenna type and feed point location. For the maximum output of a 3 W hand-held transceiver operating at 850 MHz, the worst-case peak instantaneous SARs could conceivably reach 9.6 W/kg at the surface of the eye and 10.5 W/kg at the temple. Time averaging over a six-minute period reduces these SAR values, for example, by a factor of two when transmission occurs 50% of the time during a two-way conversation using hand-held transceivers (except cellular transceivers). Frequencies in the range of 450 to 900 MHz are near the frequency of resonant absorption in the human head when exposed to plane wave EM fields. Under conditions of near-field exposure, however, the SAR decreases rather than increases in the center of the head as predicted by far-field models (Johnson and Guy, 1972).

RF energy from hand-held cellular telephones is radiated continuously during a two-way conversation, even when the user is not speaking. However, the radiated power is normally not more than 0.6 W. Measurements of exposure of the head and body from a 0.6 W hand-held cellular unit have shown that the peak SAR is 0.45 W/kg near the surface of the temporal area of the head closest to the antenna (Balzano, et al., 1984). Some people are concerned that reflection and power focusing could pose a safety risk to users of hand-held cellular transceivers inside metallic vehicles. In a vehicle, however, there are sufficient window openings at head level, so that reflections pose no additional problem. (Balzano, 1992, personal communication) Cordless telephones used in the home operate at 46 and 49 MHz, and the maximum power is usually less than 0.02 mW. The SAR produced by these units is insignificant.

### **C. Mobile Transceivers and Telephones**

Antennas for mobile transceivers are usually mounted on the roof, front or rear deck, fenders, or, at low frequencies, on the rear bumper of vehicles. Mobile transmitters used for land-mobile services, other than cellular radio, operate at power levels up to 100 W. Exposure of the vehicle's occupants or of bystanders depends generally on radiated power, frequency, type, installation and accessibility of the antenna. Information provided to the FCC by one manufacturer indicated that the exposure of a bystander from a 100 W mobile antenna may exceed the 1982 ANSI recommended limits at distances up to 30-50 cm from the antenna. However, the duty factors for such transmissions are low, and actual, time-averaged exposure at these distances would probably not exceed the guidelines. The manufacturer stated that it routinely attaches a safety warning to the "push-to-talk" microphones of its high-power equipment, cautioning the operator not to transmit if a bystander is within 60 cm of the antenna. For high-power transmitters, e.g. greater than 7 W, the operators should be aware of the safety precautions provided by the manufacturers.

The output power of a mobile cellular-transceiver, which transmits in the 824-850 MHz band, is controlled by the base station and generally does not exceed 3 W. In a vehicle equipped with a cellular transceiver, the exposure levels to driver and passengers are strongly affected by the antenna type and location. Two types of antennas are primarily used with mobile phones: car-body mounted, e.g., roof, deck or fender, and glass mounted. Glass-mounted antennas are normally placed at the center and top of the rear windshield. Exposure of occupants in the vehicle from both antenna types has been measured.

For a vehicle with an antenna located in the center of a metal roof, the measured levels inside the vehicle have been found to be 0.01-0.02 mW/cm<sup>2</sup>, depending on the vehicle's size and shape (Balzano, et al., 1986). Note that the quantity measured here is power density, not SAR. In this case, the antenna is sufficiently distant so that the electric and magnetic fields are orthogonal, and far-field conditions usually prevail. When the antenna is located at the center of the trunk lid, the exposure above the rear seat, at head level, strongly depends on the distance from the radiating structure. For most cars, the distance between the rear seat and the trunk lid is between 25 and 60 cm, and power densities measured in the rear seat are between 0.35 and 0.07 mW/cm<sup>2</sup>. Measurements of properly matched glass-mounted antennas indicate that the levels inside the vehicle are of the same order of magnitude as those from antennas located at the center of the roof (Balzano, et al., 1986).

If the car has a plastic body, the shielding effect of the metal surface is lost, and the exposure is determined primarily by the distance from the antenna. At 30 cm the maximum power density from a 3 W transmitter is about 0.3 mW/cm<sup>2</sup>. Thus, for high-power transmitters the antenna should be mounted as far away as possible from the occupants of the vehicle.

In comments filed with the FCC, one manufacturer expressed the opinion that proper installation of a vehicle-mounted antenna was an effective way of limiting exposure (Motorola, 1987) and recommended installation either in the center of the roof or the center of the trunk. Concern was expressed over the common practice of mounting cellular antennas on the rear-window, especially if used in conjunction with high-power mobile transmitters. Maintaining a minimum separation distance of 30-60 cm was recommended to minimize exposure to occupants of vehicles with plastic bodies or vehicles with metal bodies and center-window installations.

A study carried out at the University of Washington documented typical and worst-case exposure levels and the associated SARs for vehicle occupants and bystanders in the vicinity of vehicle-mounted cellular antennas (Guy and Chou, 1986). The worst-case exposure conditions were considered to occur when individuals were at the closest practicable distances from the antennas. Several configurations were tested using both adult and child "phantom" models. The results of this study showed that the highest exposure level of 1.9 mW/cm<sup>2</sup> corresponded to a female phantom model standing at a distance of 9.7 cm from a fender-mounted antenna operating at 835 MHz with 3 W delivered to the antenna. Inside the car, the maximum power density was 0.22 mW/cm<sup>2</sup> at the rear seat. Similarly, SAR measurements under corresponding conditions indicated that the transmitter power could be as high as 35 W without exceeding the 8 W/kg peak SAR limits specified in the exclusion of the ANSI C95.1-1982 standard. The maximum measured SAR in a child model leaning toward the roof-mounted antenna was 0.052 W/kg per watt of power delivered to the antenna. A maximum SAR of 0.23 of W/kg per watt of transmitted power was also measured in a child model standing 15 cm from a fender-mounted antenna. The intermittent